

# INFLUENCE OF NUCLEAR STRUCTURE ON SUB-BARRIER HINDRANCE IN Ni+Ni FUSION\*

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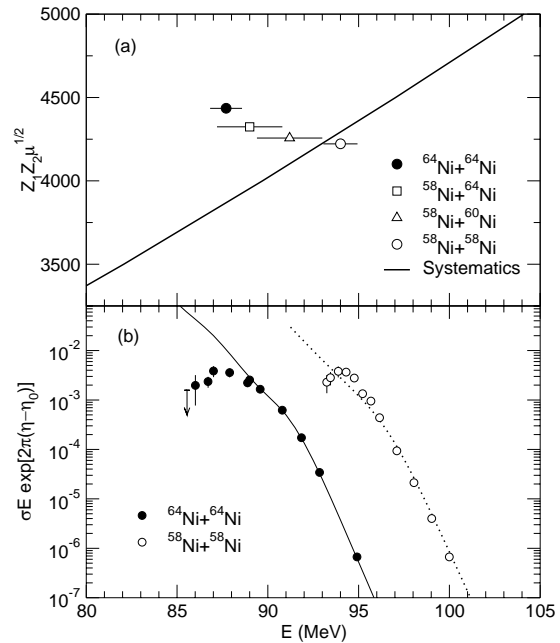
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Recently it has been shown that fusion in a large number of systems is strongly suppressed at extreme sub-barrier energies [1-3]. Standard theories of heavy-ion fusion, such as coupled-channels models, are unable to account for this effect. One parametrization of the data, which emphasizes this suppression, is to express the fusion cross section as an  $S$ -factor given by  $S = \sigma E \exp(2\pi\eta)$ , where  $E$  is the center-of-mass energy and  $\eta$  is the Sommerfeld parameter. In this representation one finds that the rapid change in slope of the sub-barrier fusion cross section results in a maximum of the  $S$ -factor as shown in panel (b) of the figure for the systems  $^{58}\text{Ni}+^{58}\text{Ni}$  and  $^{64}\text{Ni}+^{64}\text{Ni}$ . The dotted and solid curves represent coupled channels calculations, which reproduce the data at above-barrier energies. The maximum in the  $S$ -factor has been found for a number of systems involving "stiff" nuclei to follow a systematic trend given by the solid curve in panel (a) [2]. A maximum in the  $S$ -factor for fusion between two open-shell nuclei has been observed for the first time in  $^{64}\text{Ni}+^{64}\text{Ni}$ .

For this system, the cross section has been measured down to the 10 nb level [3]. A comparison between the  $^{58}\text{Ni}+^{58}\text{Ni}$ , and  $^{64}\text{Ni}+^{64}\text{Ni}$  systems indicates that the energy where the hindrance occurs depends strongly on the stiffness of the interacting nuclei. The open triangle and square symbols in panel (a) correspond to the systems,  $^{58}\text{Ni}+^{60}\text{Ni}$  and  $^{58}\text{Ni}+^{64}\text{Ni}$  for which so far only an estimated position of the  $S$ -factor maximum has been obtained. No satisfactory explanation of this sub-barrier fusion suppression has yet been put forth. The present work shows, however, that this effect appears to be directly correlated with the nuclear structure of the interacting nuclei.



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[3] C.L. Jiang *et al.*, nucl-ex/0402019, Submitted to Phys. Rev. Lett. (Feb. 2004)